8. What is the material used for hydraulic tubing that i
to intense heat?

9. What type of line is used to connect moving parts?

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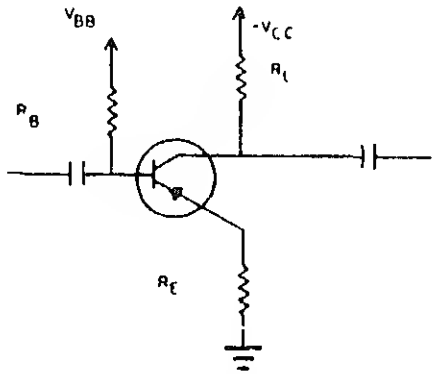
ASSIGNMENT BOOK

FOR

ADVANCED FIRST-TERM AVIONICS COU

CLASS A1

C-100-2010



UNIT II

CNTT-M1702

PREPARED BY

NAVAL AIR TECHNICAL TRAINING CENT

NAVAL AIR STATION MEMPHIS

MILLINGTON TENNESSEE

PREPARED FOR

CHIEF OF NAVAL TECHNIAL TRAINING

NOVEMBER 1984

nd on you being safety conscious at all times. It is the onsibility of all Navy and Marine Corps personnel to prevent dents. This can be done if everyone develops and practices cientious safety habits and observes all precautions when orming maintenance of any type. Always remember:

SAFETY CANNOT BE OVERSTRESSED!!!!!

d the Advanced First-Term Avionics Course (Class AI). Ampl
has been provided for all homework assignments and any
ional notes you may desire. Remember that all homework is
TORY.

book contains the following:

ssignments necessary to accomplish the Unit II objectives.

LUCK!!!!

The schedule is as follows:

TOPIC NO.	TYPE	PERIOD	
SECOND WEEK			
Fifth Day			
2.1	Class	77	Series R
		78	
		79	
2.2	Class	80	Parallel
THIRD WEEK			
First Day			
2.2	Class	81	Parallel
2.3	Class	82	Physics
		83	
		84	
2.4	Class	85	Semicond Physics
		86	
		87	
		88	
Second Day			
	Class	89	Semicond Physics
	Lab	90	PN Junct (Laborat
		91	
	Class	92	Junction tors
		93	
		94	
		95	
		96	

		98	
		99	
		100	
2.8	Class	101	Biasing Ar ments
		102	
		103	
		104	

Fourth Day

2.8	Class	105	Biasing Ar ments
		106	
		107	
2.9	Lab	108	Biasing Ar ments (La
		109	
		110	
		111	
		112	

Fifth Day

	Class	113	Unit/Modu Criterion Written E tion
		114	
		115	
2.10	Class	116	Decibels
		117	
2.11	Class	118	Feedback Amplifier
		119	
		120	

Fourth Week

First Day

2.11	Class	121	Feedback Amplifier

			Am
		125	
		126	
		127	
		128	
Second Day			
2.13	Class	129	Tra Cou
		130	
		131	
		132	
2.14	Class	133	Spe
		134	
		135	
		136	
Third Day			
2.14	Class	137	Spe
		138	
		139	
		140	
2.15	Class	141	Vac Fur
		142	
2.16	Class	143	Tri
		144	
Fourth Day			
2.16	Class	145	Tri
		146	
		147	
		148	
2.17	Class	149	Mul
		150	
		151	
		152	

Written Exami
tion

154
155
156

day when the lesson was completed. Each assignment sh
checked by an instructor for corrections and completio
Information sheets assigned with lesson topics are con
homework. Failure to complete assigned homework may r
disciplinary action.

Assignment Sheet Peri

2.1.1A

2.2.1A

2.3.1A

2.4.1A

2.6.1A

2.8.1A

2.10.1A

2.11.1A

2.12.1A

2.13.1A

2.14.1A

2.15.1A

2.16.1A

2.17.1A

UNIT LEARNING OBJECTIVES

TERMINAL OBJECTIVES

1.0 SOLVE problems related to electronic circuits, us mathematics, algebra, and trigonometry. A formul trigonometric tables, and a universal Time Consta will be provided. Performance must be in accorda mathematical principles outlined in "Mathematics, NAVPERS 10069-series, "Mathematics," Vol. III, NA 10073-series, "Basic Electronics," Vol. I, NAVPE series, and "Basic Electricity," NAVPERS 10086-se Performance will be measured by a written multipl examination.

2.0 ANALYZE the internal structure and operation of conductor junctions by tracing majority and minor current flow through a given semiconductor device accordance with quantum mechanical principles out "Basic Electronics," Vol. I, NAVPERS 10087-series "Aviation Electronics Technician 3 & 2," NAVEDTRA series. Performance will be measured by a writte multiple-choice examination.

3.0 Mathematically ANALYZE the operation of given bas conductor circuits by solving problems in terms c current, reactance, and frequency. A formula she provided. Responses must be in accordance with Electronics," Vol. I, NAVPERS 10087-series, and will be measured by a written multiple-choice exa

4.0 ANALYZE the internal structure and operation of circuits by identifying elements and their functi solving problems in terms of voltage, current re and biasing. Responses must be in accordance wit information outlined in "Basic Electronics," Vol NAVPERS 10087-series. Performance will be measu written multiple-choice examination. A formula be provided.

ENABLING OBJECTIVES

1.1 SOLVE problems involving addition, subtraction, tion, and division of radicals and exponents, us laws of exponents. Response must be in accordan "Mathematics," Vol. I, NAVPERS 10069-series. Pe will be measur d by a written ultip e-ch ice ex

A formula sheet will be provided.

1.3 SOLVE for the variables in simultaneous linear equa using the principles of matrix algebra. Responses in accordance with "Mathematics," Vol. III, NAVPERS series. Performance will be measured by a written multiple-choice examination. A formula sheet will provided.

1.4 SOLVE for total capacitance, RC time, current, and values of a simple RC switching circuit. Response in accordance with "Basic Electricity," NAVPERS 10 series. Performance will be measured by a written multiple-choice examination. A formula sheet and Universal Time Constant chart will be provided.

1.5 SOLVE for total inductance, L/R time, current, and values of a simple L/R switching circuit. Respons in accordance with "Basic Electricity," NAVPERS 10 series. Performance will be measured by a written multiple-choice examination. A formula sheet and Universal Time Constant Chart will be provided.

1.6 SOLVE for unknown current, voltage, and resistance of electronic circuits containing source character and voltage dividers. Response must be in accorda "Basic Electricity," NAVPERS 10086-series. Perfor will be measured by a written multiple-choice exam A formula sheet will be provided.

1.7 SOLVE for unknown values of current, voltage, reac and power in series and parallel a-c circuits. Re must be in accordance with "Basic Electricity," NA 10086-series. Performance will be measured by a w multiple-choice examination. A formula sheet and onometric tables will be provided.

1.8 SOLVE for unknown values of current, voltage, reac frequency, bandwidth, m and circuit "Q", in series parallel resonant circuits. Response will be in a with "Basic Electronics," Vol. I, NAVPERS 10087-se Performance will be measured by a written multiple examination. A formula sheet and trigonometric ta be provided.

series. Performance will be measured by a written multiple-choice examination.

2 SELECT, from given lists, correct statements related t properties of heat, sound, cryogenics, and the electro magnetic spectrum. Responses must be in accordance wi "Aviation Electronics Technician 3 & 2," NAVEDTRA 1031 series. Performance will be measured by a written multiple-choice examination.

3 DETERMINE normal biasing polarities of semiconductor junctions by ANALYZING majority and minority current through a given semiconductor circuit. Responses must in accordance with quantum principles outlined in "Bas Electronics," Vol. I, NAVPERS 10087-series. Performan will be measured by a written multiple-choice examinat

DETERMINE biasing arrangements of semiconductor circui by SOLVING problems in terms of voltage, current, reactance, and frequency. Responses must be in accord with "Basic Electronics," Vol. I, NAVPERS 10087-series Performance will be measured by a written multiple-cho examination. A formula sheet will be provided.

2 DETERMINE capabilities, electrical characteristics, advantages and disadvantages of given semiconductor circuits by SOLVING problems in terms of voltage, curr reactance, and frequency. Responses must be in accord with "Basic Electronics," Vol. I, NAVPERS 10087-series formula sheet will be provided.

3 COMPUTE decibel gain and loss in terms of the voltage power of a given semiconductor amplifier circuit. Responses must be in accordance with "Basic Electronic Vol. I, NAVPERS 10087-series. A formula sheet will be vided. Performance will be measured by a multiple-cho examination.

4 BUILD basic semiconductor amplifier circuits (under su vision). MEASURE values and RECORD measurements, calc tions, and evaluations on a job sheet, given necessary equipment and an RCA 6F16 transistor trainer. Accurac will be measured in accordance with information contai in "Basic Electronics," Vol. I, NAVPERS 10087-series.

.2 SOLVE problems in terms of voltage, current, resistanc biasing, using vacuum-tube formulas and tube constants Responses must be in accordance with information outli in "Basic Electronics," Vol. I, NAVPERS 10087-series. Performance will be measured by a written multiple-cho examination. A formula sheet will be provided.

The purpose of this assignment sheet is to familiarize yo
various aspects of series resonant circuits. Considerati
given to both an operational analysis and mathematical an
well as certain characteristics unique to these circuits.

LESSON TOPIC LEARNING OBJECTIVES

1.8.1. SELECT, from a list of circuit conditions, those
to a series resonant circuit.

1.8.2. SOLVE, given a series circuit with specified valu
inductance and capacitance, for the resonant freq

1.8.3. SOLVE, given a series resonant circuit with speci
values of capacitance and the resonant frequency,
value of inductance.

1.8.4. SOLVE, given a series resonant circuit with speci
values of inductance and the resonant frequency,
value of capacitance.

1.8.5. SOLVE, given a series resonant circuit with speci
values of X_L, X_C, R and F_O, for the series resona
functions of Q, BW, f_1, f_2.

1.8.6. SOLVE, given a series resonant circuit with speci
values of X_L, X_C, R and E_a, for E_C, E_L, and E_r.

1.8.7. SELECT, from a list provided, circuit characteris
and below resonance.

1.8.8. IDENTIFY and LABEl frequency response curves to i
a. An impedance response curve of a series circu
b. A current response curve of a series resonant
c. Z_{min}, I_{max}, I_{f1}, I_{f2}, Z_{f2}.

1.8.9. SOLVE, for series resonant circuit functions, P_a,
P_f, using specified values of current, voltage, a
resistance.

1. Circle the letter beside each condition listed belo
applies to a series resonant circuit.

a. Z is minimum

b. P_t is greater than P_a.

c. $X_L = X_C$

d. I is minimum.

e. P. F. = 1

f. Phase angle = 0°.

g. I is maximum

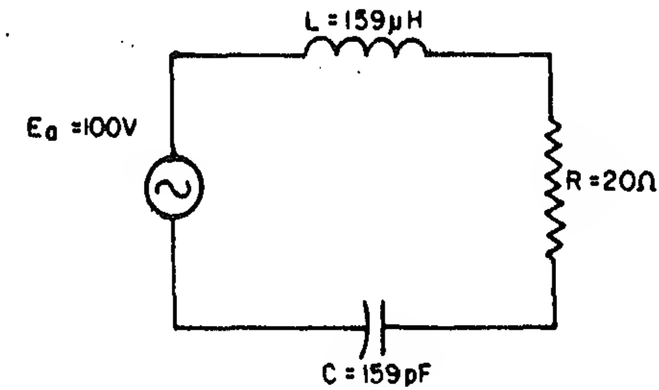
h. Phase Angle i

i. Z = R

j. Z is maximum.

k. $P_t = P_a$

2. What is the resonant frequency of the circuit below



f_o = ______________

L = ______

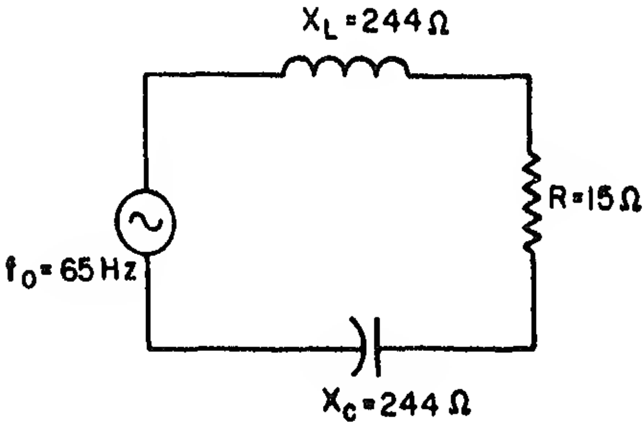
What value of capacitance must be used with a .318 H coil
have a series circuit resonant to 95 kHz?

C = ______

following results in a series resonant circuit.

Results	App fre
X_L becomes X_Y	___
Circuit appears capacitive and resistive to the source.	___

6. Using the circuit values below, solve for Q, BW, f f_2.



Q =

BW =

f_1 =

f_2 =

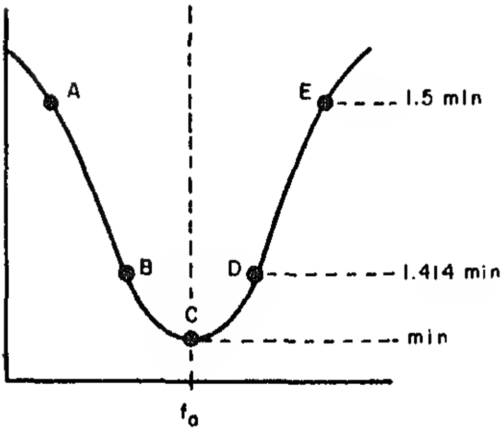
7. A series resonant circuit that has a high L to C

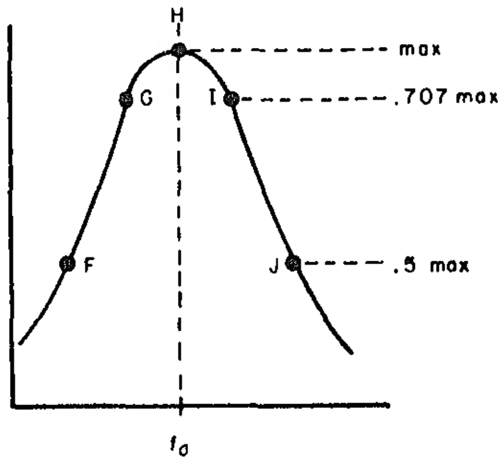
_______________ circuit Q and a __________ banc

a. Label the impedance response curve of a series resonan circuit.

b. Label the current response curve of a series resonant circuit

c. Fill in each blank with the letter which represents th corresponding point on the proper graph.



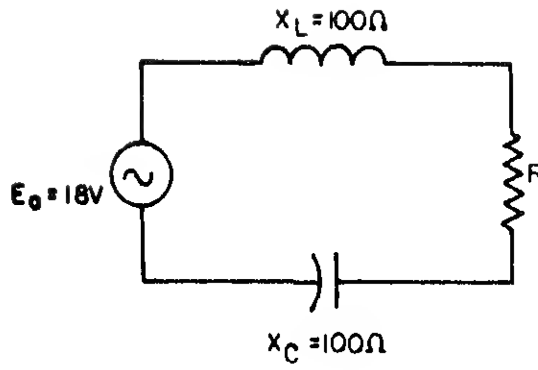


____________ (type)

____________ (type)

x____________ Z_{f_1}____________ I_{f_1}____________

n____________ Z_{f_2}____________ I_{f_2}____________

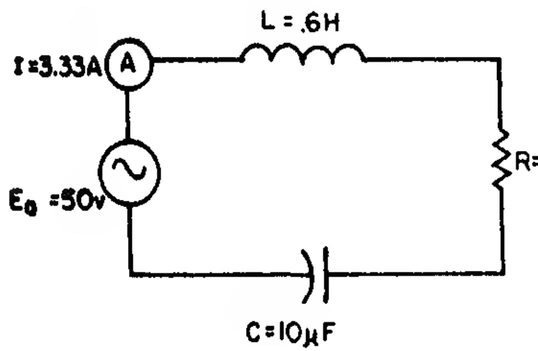


P_a = ______

P_t = ______

P_f = ______

). Using the series resonant circuit values shown below, solve
E_C, and E_R.



E_L = ______

E_C = ______

E_R = ______

INTRODUCTION

The purpose of this assignment sheet is to familiarize yo various aspects of parallel resonant circuits. Considera be given to both an operational analysis and mathematical as well as certain characteristics unique to these circui

LESSON TOPIC LEARNING OBJECTIVES

1.8.10. SELECT, from a list provided, the correct functi I_{line} in a parallel resonant circuit.

1.8.11. SELECT, from a list provided, the condition of I parallel circuit at resonance.

1.8.12. SOLVE, given specified values of L and C, for th frequency.

1.8.13. SOLVE, given the values of R, X_C, X_L, and E_a, fo correct values of Q, Z, I_{line}, and I_{circ}.

1.8.14. SELECT, from a given list, the correct purpose o swamping resistor in a parallel resonant circuit

1.8.15. SELECT, from a list provided, circuit characteri above and below resonance.

1.8.16. IDENTIFY and LABEL the following on given freque response curves:

a. The impedance response curve of a parallel r cirouit.

b. The current response curve of a parallel res circuit.

c. The following points indicated on the curves

(1) Z_{max}
(2) I_{min}
(3) I_{f1} and I_{f2}
(4) Z_{f1} and Z_{f2}

1.8.17. SOLVE, for the parallel resonant circuit functio and P_f using specified values of E_{app} and I_{line}.

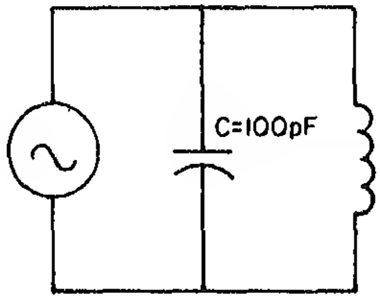
____

____

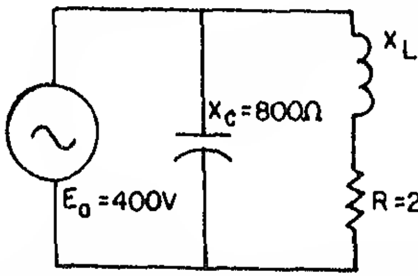
2. When a parallel circuit is operating at its resonant frequ
I_{circ} is ____________________ and I_{line} is
(minimum/maximum)

____
(minimum/maximum)

3. Solve for the resonant frequency of the circuit below.



4. Using circuit values shown below, solve for the following
Q, Z, I_{line}, I_{circ}.



5. Solve for the bandwidth of a parallel resonant circuit, u
the following information: F_o = 1500 kHz, X_L = 2400 $/\underline{+90}$
ohms, R = 8 $/\underline{0°}$ ohms.

What is the characteristic impedance of a parallel circuit

a. at the resonant frequency? ____________________

b. below the resonant frequency? ____________________

c. above the resonant frequency? ____________________

The purpose of this assignment sheet is to familiarize y
the material covered in the physics overview lesson.

LESSON TOPIC LEARNING OBJECTIVES

2.2.1. SELECT, from a list provided, the three forms in
matter can exist.

2.2.2. SELECT, from a list provided, the definition of

2.2.3. SELECT, from a list provided, the definition of

2.2.4. SELECT, from a list provided, the definition of

2.2.5. SELECT, from a list provided, the definition of

2.2.6. SELECT, from a list provided, the relationship t
between energy and matter.

2.2.7. SELECT, from a list provided, the definition of

2.2.8. SELECT, from a list provided, the definition of
conductivity.

2.2.9. SELECT, from a given list, the definition of sou

2.2.10. SELECT, from a given list, the definition of fre

2.2.11. SELECT, from a given list, the definition of the
spectrum.

2.2.12. SELECT, from a given list, the definition of hea

2.2.13. SELECT, from a given list, the definition of tem

2.2.14. SELECT, from a given list, the six sources of he

2.2.15. MATCH, given a list of definitions, the terms Br
Thermal Unit, calorie, and Calorie.

2.2.16. MATCH, given a list of definitions, the terms co
convection, and radiation with their respective
definitions.

2. State the definition of cohesion.

3. Define mass.

4. State Newton's Law of Inertia.

5. State the definition of adhesion.

6. Give the definition of energy.

7. List the two kinds of energy.

8. State the relationship between matter and energ

9. State the definition of cryogenics.

10. Give the definition of absolute zero.

11. Give the definition of superconductivity.

12. What is the velocity of sound at sea level at 3

13. Give the frequency range of the audio spectrum.

14. Define light.

15. Give the definition of the optical spectrum.

16. Define heat.

b. Temperature is a measure of the ability of a mat
contain heat.

c. Temperature is a measure of the absorption or ra
of heat by a material over a period of time.

d. Temperature is a measure of the ability of a mat
generate heat from contact with another material

18. List the six sources of heat.

1.__________ 2.__________ 3.__________ 4.__________

5.__________ 6.__________

19. Match the units of heat measurement in column A with
definitions in column B.

A	B
___(1) One B.T.U.	a. The quantity o needed to rais temperature of Kilogram of wa Celsius (centi degree.
___(2) One Calorie	b. The quantity o needed to rais temperature of of water one F degree.
___(3) One Calorie	c. The quantity o needed to rais temperature of grams of water Celsius (centi degree.
	d. The quantity o needed to rais temperature of grams of weter Fahrenheit deg

20. Match each term in column A with its definition in

___(1) Conduction

___(2) Convection

___(3) Radiation

a. Transfer of h
electron flo

b. Transfer of h
motion of a

c. Transfer of h
molecule to m

d. Transfer of h
electromagne

e. Transfer of h
mechanical m

The purpose of this assignment sheet is to familiarize yo
various aspects of semiconductor physics and PN junctions
Consideration will be given to the operational analysis a
teristics of the unique characteristics of semiconductor

LESSON TOPIC LEARNING OBJECTIVES

2.1.1 MATCH, given a list, the terms molecule, elemen atom, with their respective definitions.

2.1.2 NAME, given a diagram, three sub-atomic particl atom.

2.1.3 STATE the requirements for chemical stability o

2.1.4 CALCULATE, given the correct formula, the maxim number of electrons in a specified energy shell atom.

2.1.5 SELECT, given a list, the three types of bondin occurs between atoms.

2.1.6 MATCH, given a list of definitions, the terms c semiconductor, and insulator with their respect definitions.

2.1.7 SELECT, from a given list, the requirements fo a valence electron into mobility.

2.1.8 SELECT, from a given list, the definition of co bonding.

2.1.9 SELECT, from a given list, the number of valenc electrons in donor and acceptor atoms.

2.1.10 STATE, in the space provided, which type of im will produce N- or P- type materials, when adde silicon or germanium.

2.3.3 SELECT, from a given list, the definition of

2.3.4 SELECT, from a given list, why ions are prese
junction of an unbiased PN junctions.

2.3.5 DRAW, in the space provided, a PN junction, s
potential barrier with its proper polarities.

2.3.6 SELECT, from a given list, why the potential
exists in a PN junction.

2.3.7 SELECT, from a given list, the effect of incr
decreasing the doping level on the width of t
region.

2.3.8 SELECT, from a given list, the effect of incr
decreasing the doping level on the height of
potential.

2.3.9 SELECT, from a given list, the factor which p
total recombination of holes and electrons wh
junction is formed.

2.3.10 DRAW, in the space provided, a forward biased
junction, showing the source and list the eff
forward bias has on the width of the depletio

2.3.11 DRAW, in the space provided, the mil-spec sym
diode and label the N material, P material, a
cathode.

c. molecule.
d. atom.

2. Substances made up of atoms of one kind are __________

3. Substances made up of different kinds of atoms are ca

______________.

4. An atom is neutral when the number of neutrons equals
number of electrons.

__________ a. True

__________ b. False

5. Group II elements have how many valence electrons?

a. 1
b. 2
c. 3
d. 4

6. Which of the following "valence groups" are insulator

a. 4, 5, 6, and 7
b. 3, 4, 5, and 6
c. 1, 2, and 3
d. 5, 6, 7, and 8

7. Covalent bonding in germanium is a method of bonding
the atoms share electrons, so that each one will have
electrons in its valence shell.

a. True
b. False

8. The "M" shell of an atom could have a maximum of how
electrons?

a. 2
b. 6
c. 32
d. 18

c. 3
d. 4

10. A germanium atom contains

a. four protons.
b. four valence electrons.
c. six valence electrons.
d. only two electron orbits.

11. A normal atom is one which

a. always has an atomic core with a charge of
b. always has four valence electrons.
c. has equal numbers of electrons and protons
d. shares its electrons with other atoms.

12. When atoms are held together by the sharing of electrons

a. they form a covalent bond.
b. they always form a diamond lattice structu
c. the valence electrons are free to move awa
d. each shared electron leaves a hole.

13. When the temperature of an intrinsic semicondu

a. the resistance of the semiconductor increa
b. the heat decreases the energy of the atoms
c. holes are created in the conductor band.
d. the energy of the atom in increased.

14. A hole is the vacancy created when

a. an electron moves from the conductor band band.
b. an atomic core moves.
c. an electron breaks its covalent bond.
d. a free electron is made to move by an appl

15. The movement of a hole is brought about by the

a. vacancy being filled by a free electron.
b. vacancy being filled by a valence electron neighboring atom.
c. movement of the atomic cores.
d. atomic core changing from 1 +4 to a +5 cha

d. must have only three valence electrons.

The forbidden energy gap in semiconductors

a. lies just below the valence band.
b. lies just above the conduction band.
c. lies between the valence band and the conduction band
d. is the same as the valence band.

In a P-type semiconductor

a. the number of holes equals the number of free electro
b. holes are the majority carriers.
c. the forbidden energy gap is zero.
d. the impurity is a donor impurity.

In N-type germanium, the

a. forbidden energy gap is greater than in N-type silico
b. impurity has three valence electrons.
c. number of holes equals the number of free electrons.
d. holes are the minority carriers.

The energy required to break a covalent bond in a semiconductor is

a. equal to 1 eV.
b. equal to the width of the forbidden gap.
c. greater in germanium than in silicon.
d. the same in germanium as in silicon.

Current flow in a P-type semiconductor is

a. mostly by the movement of free electrons.
b. by majority carriers only.
c. by minority carriers only.
d. mostly by the movement of holes.

In semiconductors, resistivity

a. is the same as resistance
b. depends on temperature.
c. is the same as mobility.
d. increases as conductivity increases.

c. charge per carrier.
d. temperature and the regularity of the crystal

24. The change in carrier concentration along the len
semiconductor is called

    a. diffusion length.
    b. a concentration gradient.
    c. recombination rate.
    d. mobility.

25. When a free electron is recaptured by a hole and
hole, the process is called

    a. recombination.
    b. diffusion.
    c. thermal equilibrium.
    d. lifetime.

26. The movement of charges from an area of high carr
tration to an area of lower carrier concentration

    a. gradient.
    b. recombination.
    c. diffusion.
    d. lifetime.

27. The movement of carriers by an applied voltage is

    a. drift current.
    b. diffusion current.
    c. mobility.
    d. concentration.

28. Valence electrons are the electrons that take par
covalent bond

    a. true
    b. false

29. A semiconductor that is electrically neutral has

    a. no free charges.
    b. no majority carriers.
    c. equal amounts of positive and negative charge
    d. no minority carriers.

d. is then free to move about.

31. The potential barrier at a PN junction is due to the
on either side of the junction. These charges are

a. majority carriers.
b. minority carriers.
c. both majority and minority carriers.
d. fixed donor and acceptor ions.

32. Holes diffuse from the P region to the N region beca

a. there is a greater concentration of holes in th
b. they are swept across the junction by the poten
difference.
c. the free electrons in the N region attract them
d. none of these.

33. If the junction current is zero, this means

a. the potential barrier has disappeared.
b. the number of holes diffusing from the P region
number of electrons diffusing from the N region
c. there are no carriers crossing the junction.
d. the number of majority carriers crossing the ju
equals the number of minority carriers crossing
junction.

34. The junction potential barrier offers opposition to

a. holes in the P region.
b. mobile electrons in the N region.
c. minority carriers in both regions.
d. majority carriers in both regions.

35. Total recombination of all mobile carriers is preve

a. covalent bonds in the depletion region.
b. mobile carriers in the P-type material.
c. mobile carriers in the N-type material.
d. immobile carriers in the depletion region.

c. positive terminal to P-type material.

37. When forward bias is increased, the potential barr

a. lower.
b. higher.
c. wider.

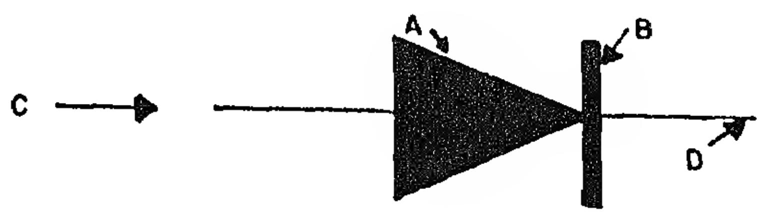
38. Amount of minority carrier flow depends on

a. potential of reverse bias.
b. potential of forward bias.
c. temperature.
d. potential barrier height.

39. The amount of reverse bias a PN junction can safel
is limited by the

a. width of the potential barrier.
b. amount of power the device can handle.
c. type material the device is made of.
d. size of the external supply.

40. On the schematic representation of the PN diode be
element is the cathode?



When PN junctions are formed, what determines the width o
depletion region?

a. type of semiconductor material used
b. physical size of semiconductor
c. amount of impurities used in doping
d. speed at which mobile carriers move

Regarding bias, answer the following (underline the lette
the correct choice).

a. A negative potential connected to the N material of d
   forces the electrons toward/away from the junction.
b. A negative potential applied to the P material of a d
   forces the holes toward/away from the junction.
c. For majority carrier conduction through a diode, forw
   reverse bias is applied.
d. The diode conducts when holes and electrons combine a
   near the junction. True/False

INTRODUCTION

The purpose of this assignment sheet is to familiarize
various aspects of junction transistors. Consideratic
given to the characteristics of junction transistors a
operational analysis.

LESSON TOPIC LEARNING OBJECTIVES

3.1.1 SELECT, from a given list, the three basic m transistor action.

3.1.2 DRAW, in the space provided, the external an current paths of a PNP and an NPN transistor

3.1.3 DRAW, in the space provided, a schematic rep of PNP and an NPN transistor, labeling the t voltages and currents with the proper notati

3.1.4 SELECT, from a given list, the correct termi and their relative magnitudes required to pr PNP or an NPN transistor.

3.1.5 DEVELOP, equations showing the mathematical between I_C, I_E, and I_B in a properly biased

3.2.1 DRAW, in the space provided, the three basic circuit configurations.

3.2.2 SELECT, from a given list, the characteristi common-base amplifier.

3.2.3 SELECT, from a given list, the characteristi common-collector amplifier.

3.2.4 SELECT, from a given list, the characteristi common-emitter amplifier.

3.2.5 SELECT, from a given list, the main advantag advantages of each of the three configuratic

3.2.6 SELECT, from a given list, the effect that h the reverse current in a PN junction.

input signal.

Y QUESTIONS

What are the three basic mechanisms of transistor operation?

___________, ____________, and ____________.

External current flows in/out the collector and in/out the emitter of an NPN-type transistor.

Majority carriers in an NPN-type transistor are holes/elect and flow from emitter/collector to emitter/collector.

From a schematic representation of a PNP transistor, how ca the emitter element be identified?

What does the notation, V_{BE} indicate?

For proper bias, what is the polarity relationship of the b to emitter in a PNP transistor?

What is the correct mathematical relationship of transistor currents?

a. $I_C = E_C + I_B$
b. $I_B = I_C + I_E$
c. $I_C = I_C + I_B$
d. $I_C = I_E + I_B$

d. input resistance of common-base amplifier.

9. Match notations in "B" to column "A".

Column A	Column
a. ______ B	a. V_B
b. ______ forward bias	b. V_C
c. ______ collector supply	c. B
d. ______ most positive element of PNP transistors	d. el
e. ______ majority carriers in NPN transistor	e. ho
f. ______ minority carriers in PNP transistors	f. co
	g. em
	h. I_B

10. What are the three different circuit configuration transistor can be employed in?

____________________, ____________________ and ______

11. Which circuit configuration is capable of giving h current gain?

12. In the PNP transistor, electrons flow

a. into the transistor at the emitter and base le
b. out of the transistor at the emitter and base
c. into the transistor as the collector and base
d. out of the transistor at the collector and bas

13. The common-base current transfer ratio is the rati

a. $\frac{\Delta I_C}{\Delta I_E}$

b. $\frac{\Delta I_B}{\Delta I_E}$

c. $\frac{\Delta I_E}{\Delta I_C}$

d. $\frac{\Delta I_C}{\Delta I_B}$

). collector bias supply.
:. collector bias supply less the voltage drop across the load resistor.
l. collector bias supply plus the voltage drop across the load resistor.

Vhen a positive voltage signal is applied to the base of a iormally biased NPN common-emitter amplifier the

:. emitter current decreases.
). collector voltage goes less positive.
:. base current decreases.
l. collector current decreases.

ılpha cutoff frequency is where

. alpha becomes zero.
). output power is reduced to one-tenth of its original value.
:. alpha becomes .707 its original value.
l. punch-through occurs.

f a transistor is operated at a frequency above the alpha :utoff frequency

. the transistor will burn out.
). there will be no output power.
:. the emitter junction must be forward biased.
. the output current will be reduced.

NTRODUCTION

he purpose of this assignment sheet is to familiarize you
arious aspects of biasing arrangements. Consideration wi
o both the operational analysis and mathematical analysis
ertain characteristics unique to these circuits.

ESSON TOPIC LEARNING OBJECTIVES

.2.9. SELECT, from a given list, what establishes the o
point of a transistor amplifier.

.2.10. CALCULATE, given a schematic diagram and circuit
operating point of a transistor amplifier.

.2.11. CALCULATE, given a schematic diagram, circuit val
an input signal, the peak-to-peak amplitude of th
signal of a transistor amplifier.

.2.12. SELECT, from a given list, the statement that des
effect of temperature changes on the operating po
transistor amplifier.

.2.13. SELECT, from a given list, the definition of I_{CO},
and I_{CEO}.

.2.14. SELECT, from a given list, the need for bias stab

.2.15. SELECT, from a given list, the effect that bias s
has on circuit gain (A_V).

.2.16. SELECT, from a given list, how circuit stability
by the addition of an emitter resistor in the com
amplifier.

.2.17. SELECT, from a given list, the effect on the comm
amplifier's gain by the addition of an emitter by
capacitor.

.2.18. SELECT, from a given list, the effect on the comm
amplifier's stability when a voltage divider is u
base circuit.

.2.19. SELECT, from a given list, the effect on the comm
amplifier's stability when the collector is retur
base.

for the stability factor of a given common-emitter ampli

2. SELECT, from a given list, the statement that describes I_{CO} has a minimum effect on the common-base amplifier.

3. SELECT, from a given list, the effect a continually increasing junction temperature has on an unstabilized common-emitter amplifier.

4. SELECT, from a given list, the statement that describes the common-collector amplifier has inherent temperature stability.

2. What effects are stabilized by the addition of
resistor?

3. By what factor is I_{CBO} increased in a grounde

4. What is the purpose of bias stabilization?

5. What are two factors that will cause an opera
amplifier's operating point to shift?

6. What is the need for stabilization when a tra
replaced?

7. List three methods of increasing the stabili
emitter amplifier.

8. Which amplifier configuration has the best s

9. What advantage does a stabilized amplifier ha
unstablized amplifier?

10. What is the disadvantage of stabilizing an o

RODUCTION

purpose of this assignment sheet is to familiarize you with
ious aspects of determining logarithms and their functions in
ermining the power of various circuits. In this discussion w
l find that this power is expressed in decibels. Considerati
l be given to the mathematical analysis of the power expressi

SON TOPIC LEARNING OBJECTIVES

.1. SELECT, from a given list, the definition of a bel.

.2. SELECT, from a given list, the definition of a decibel.

.3. SELECT, from a given list, the formula which expressed decibels in terms of input and output power.

.4. SELECT, from a given list, the formula which expresses decibels in terms of input and output current.

.5. SOLVE, given the input and output power, for the gain ir

.6. SOLVE, given a power ratio, the decibel equivalent.

.7. SOLVE, given the input power and decibel rating, for the output power.

.8. SOLVE, given a voltage ratio, for the corresponding deci loss.

.9. SOLVE, given the proper power waveform, the F_1 and F_2 po with their proper decibel levels.

DY QUESTIONS

State the definition of a bel.

---

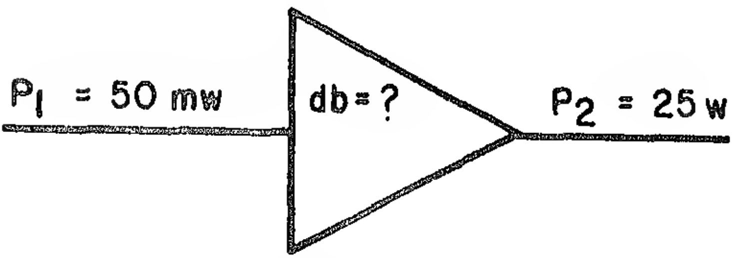
d. 36 $\log_{10}$

3. State the antilogs of the following logarithms.

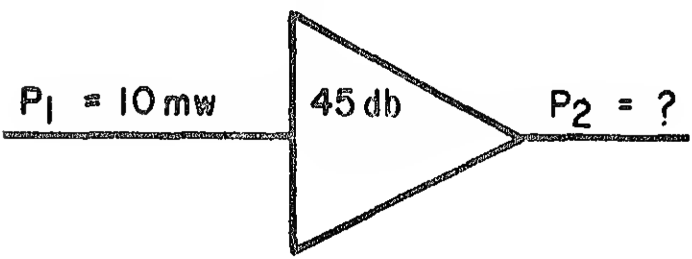
a. 13. antilog
b. .698 antilog
c. 6.35 antilog
d. 2.0 antilog

4. State the formula for decibels in the terms of input power.

5. Solve for the decibel gain of the amplifier below.



6. Solve for the output power of the amplifier below.



State the correct reference (zero) levels for dB, dBm, and d

a. dB

b. dBm

c. dBV

The power at the F_1 point is how many dB below the power at

5	6990	7076	7160	7243	7324	7404	7482	7559	7634	7709
6	7782	7853	7924	7993	8062	8129	8195	8261	8325	8388
7	8451	8513	8573	8633	8692	8751	8808	8865	8921	8976
8	9031	9085	9138	9191	9243	9294	9345	9395	9445	9494
9	9542	9590	9638	9685	9731	9777	9823	9868	9912	9956
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	396
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	413
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	429
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	445
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	460
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	475
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	490
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	503
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	517
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	530
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	542
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	555
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	567
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	578
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	589
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	601
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	611
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	622
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	632
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	64
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	65
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	66
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	67
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	680
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	689
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	69
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	70
N	0	1	2	3	4	5	6	7	8	

COMMON LOGARITHMS

N	0	1	2	3	4	5	6	7	8	9
50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7050	7059	7067
51	7076	7084	[illegible]	[illegible]	[illegible]	7118	[illegible]	7135	7143	7152
52	7160	7168	7177	7185	7193	7202	[illegible]	7218	7226	7235
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701
59	[illegible]	7716	[illegible]	7731	7736	7745	7752	7760	7767	7774
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627
73	8633	8639	8645	8651	8657	8663	8669	8675	8661	8686
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440
88	9445	9450	9455	9460	9465	9469	9474	[illegible]	9484	9489
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633
92	9636	9643	9647	9652	9657	9661	9666	9671	9675	9680
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727

INTRODUCTION

The purpose of this assignment is to familiarize you with t
various types and uses of feedback. Consideration will be
both operational and mathematical analysis of the circuits.

LESSON TOPIC LEARNING OBJECTIVES

3.2.25. SELECT, from a given list, the characteristics of
loop amplifier.

3.2.26. SELECT, from a given list, the purpose of a closed
amplifier system.

3.2.27. SELECT, from a given list, the definitions for e_{in}
A_f, and e'_{out}.

3.2.28. SELECT, from a given list, the definition of reger
feedback.

3.2.29. SELECT, from a given list, the definition of deger
feedback.

3.2.30. SELECT, from a given list, the advantages of a clo
feedback system over an open-loop system.

3.2.31. CALCULATE, given a transistor amplifier circuit co
with component values, input signal voltages, and
gain, e_f, A_f, and e'_{out}.

3.2.32. SELECT, from a given list, the effect that degener
or regenerative feedback has on the input signal.

3.2.33. SELECT, from a given list, the definition of feedb

3.2.34. CALCULATE, given a block diagram of the closed loo
system with specific values, for the value of e'ou
e_f, and e.

3.2.35. IDENTIFY, given a schematic diagram of a multistag
sistor amplifier using feedback, for the class and
the feedback used.

1. In a negative feedback system, the phase relationship the feedback voltage and the input voltage at mid-fre would be

____a. zero.
____b. 90°.
____c. 180°.
____d. 270°.

2. In an amplifier, the effect on stage gain caused by n voltage feedback is

____a. increased buy constant gain over a wider rang frequencies.
____b. decreased but constant gain over a narrower r frequencies.
____c. decreased but constant gain over a wider rang frequencies.
____d. increased but variable gain over a narrower r frequencies.

3. What is the meaning of the expression "Beta e"$_{out}$ as feedback?

____a. A fraction of the output voltage used for fee
____b. The portion of the voltage to be ignored.
____c. The part of the output voltage appearing at t collector.
____d. The equivalent of the base voltage.

4. Which position of the switch shown in figure 1 would degenerative voltage feedback in the circuit?

____a. A
____b. B
____c. Both A and B
____d. Neither
____e. C

5. Why is the dgenerative feedback loop normally limited than two or three stages of amplification?

____a. Excessive gain reduction.
____b. Possibility of circuit oscillations.
____c. Insufficient amplitude of feedback voltage.
____d. Excessive reduction in maximum power output (figure 1).

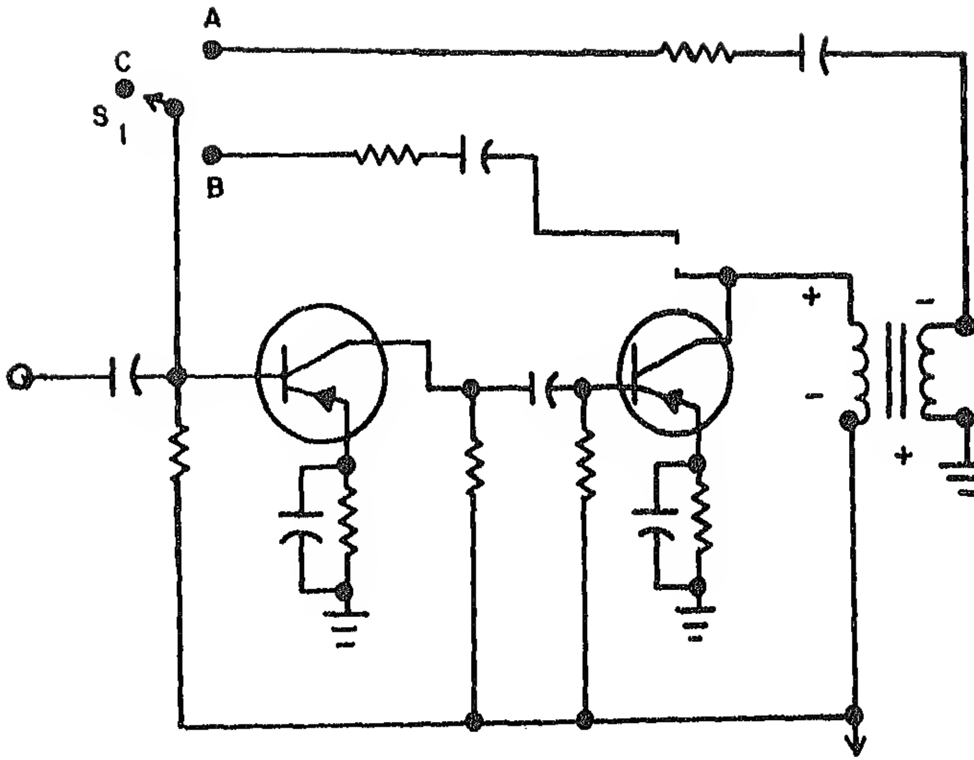


Figure 1

_____d. e_{fb} is equal to $R_E \times \Delta I_E$.

_____e. The type of feedback is voltage feedback.

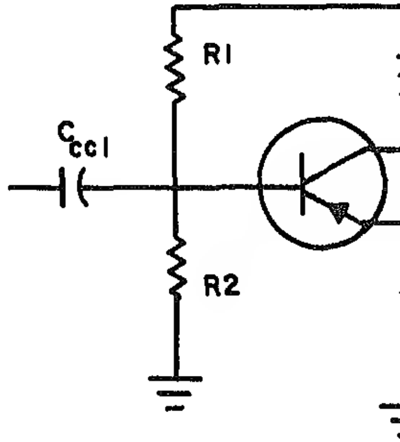


Figure 2

7. Using figure 3, select the correct statements.

_____a. The type of feedback is a-c voltage and a-

_____b. The type of feedback is a-c voltage.

_____c. Beta is the ratio of R_i to R_f+R_i.

_____d. Beta is the ratio of R_i to $R_f + R_E$.

_____e. C_E is to prevent regeneration.

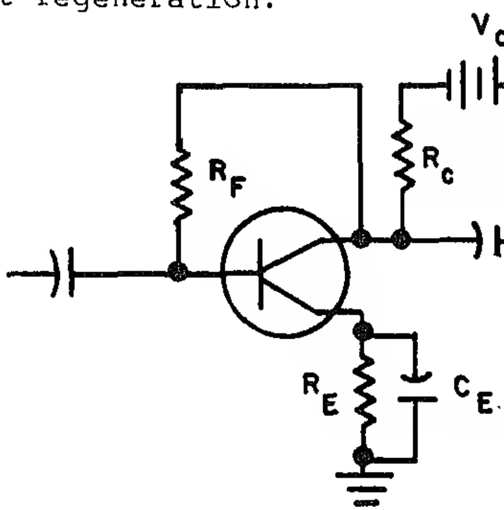
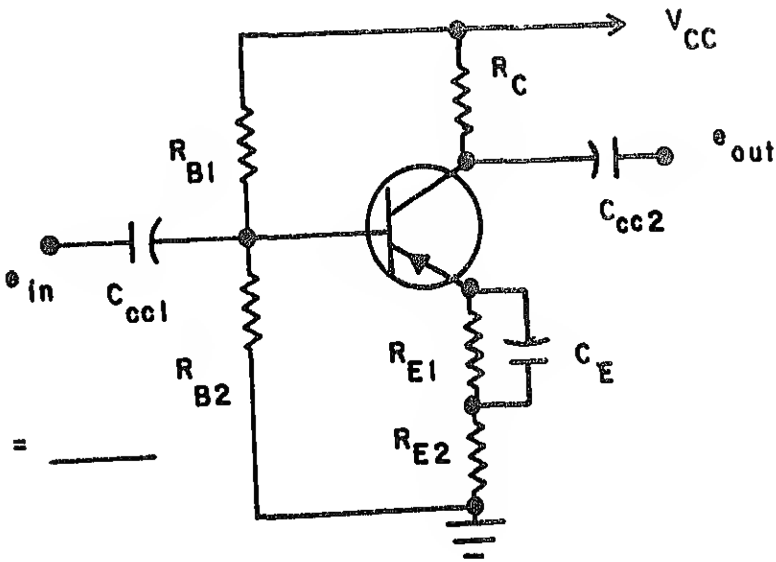


Figure 3

8. In figure 3, if C_E opens, select the correct statements

_______ a. f_2 increases.
_______ b. Output signal increases.
_______ c. Degenerative feedback increases.
_______ d. Bandwidth decreases.
_______ e. Regeneration increases.
_______ f. Input resistance increases.
_______ g. Output resistance decreases.

9. Using figure 4, compute the gain of the stage with feed applied.



A_f = ________

Given:

R_C = 1k ohms.

e_{in} = 2.5 mV

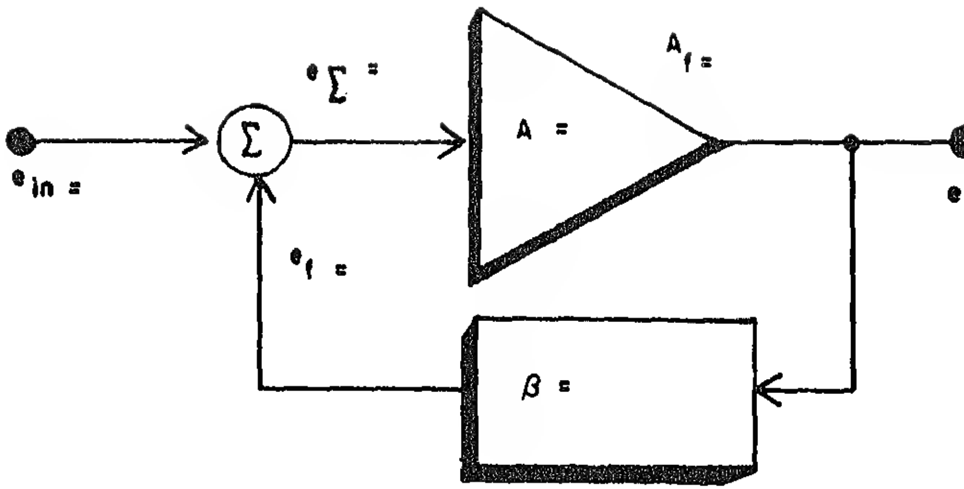


FIGURE 5

NTRODUCTION

ne stage of amplification is seldom enough to raise the am signal to the required level. The methods of coupling us ultistage amplifier depends upon many variables. Each met oupling has its advantages and disadvantages. One method ill need to concern ourselves with is the direct-coupled m is assignment sheet is also a self-check to test your und f operational amplifiers and their uses. It is essential echnicians have a working knowledge of direct coupling and haracteristics and operation of the op-amp.

ESSON TOPIC LEARNING OBJECTIVES

.2.36. SELECT, from a given list, the reason why coupling capacitors are not used in direct-coupled amplifie

.2.37. SELECT, from a given list, the major advantages of coupling.

.2.38. SELECT, from a given list, the reason why componen for direct coupling must be carefully chosen.

.2.39. SELECT, from a given list, the reason for using co connected transistors.

.2.40. SELECT, from a given list, the purpose of the bala differential amplifier.

.2.41. SELECT, from a given list, the desirable character a balanced differential amplifier.

.2.42. SELECT, from a given list, the definition of an op amplifier.

.2.43. SOLVE, for the output voltage of an op-amp when gi input voltage, feedback impedance, and input imped

.2.44. SELECT, the standard symbol for a differential amp

.2.45. SELECT, the correct statement that describes the c differential amplifier.

.2.46. COMPUTE, the output of a differential amplifier wh a schematic diagram, component values, and input v

b. Frequency response
c. Complicated circuitry
d. Expensive to construct

2. Direct-coupled amplifiers are normally used when

   a. large signal inputs are used
   b. high frequencies are applied to the circuit
   c. when a narrow bandwidth is required
   d. amplification of direct current (zero frequency
      required

3. What type of compound connected circuit allows almo
   current gain?

   a. Complementary symmetry
   b. Common-emitter cofiguration
   c. Common-base configuration
   d. Common-collector configuration

4. Write the definition of an operational amplifier.

   ____

   ____

5. Describe the relative amplitude of the voltage dev
   the summation junction of an op-amp.

   ____

   ____

6. Describe the output of a summing amp.

   ____

feedback paths.

Calculate the output voltage of a differential amplifier input resistors are 10 kohms, the feedback is 5 kohms, ar input voltages are both 2Vd-c.

_______________Vd-c

What happens to the gain of a basic op-amp if the input r is increased in value?

____

Describe the open-loop gain and the closed-loop gain in a amp.

Open-loop gain _________________________________

Closed-loop gain _______________________________

State several applications of op-amps. ____________

____

If the input resistor and feedback resistor are both equa 1 megohm, what is the gain of the circuit?

If R_f is increased, what happens to gain of the stage?

Find E_o in the circuit below.

Where:
R_{in} = 1.5 Megohm
R_f = 1 Megohm
E_{in} = 4.5.V

DUCTION

age of amplification is seldom enough to raise the amplit
nal to the required level. The methods of coupling used i
stage amplifier depends upon many variables. Each method
ing has its advantages and disadvantages. The method that
need to ooncern ourselves with is transformer ooupling.
tial that we as technicians have a working knowledge of t
of coupling.

ON TOPIC LEARNING OBJECTIVES

47. SELECT, from a given list, the major advantage of tra
coupling.

48. SELECT, from a given list, the major disadvantage of
former coupling.

49. SELECT, from a given list, the losses incurred in tr
cirouits.

50. SELECT, from a given list provided, the definitions
currents, hysteresis losses, copper losses, and flux
leakage.

.51. CALCULATE, given a transformer and specific values,
E_x, I_p, I_s, Z_p, and Z_s.

.52. SELECT, from a given list, the characteristics which
the high and low frequency response of a transformer

c. Poor power gain
d. Large size

2. An iron-core transformer is connected to a 115 volt sour
draws 38.6 mA of current. The output voltage is 230 vol
18.9 mA. The transformers efficiency is

a. 10.2%.
b. 50%.
c. 95%.
d. 98%.

3. A transformer loss that is NOT heat, but which decreases
former efficiency is

a. eddy currents.
b. copper loss.
c. flux leakage.

. Which of the following helps reduce eddy currents in a t
core?

a. Use of high-permeability, low-retentivity cores
b. Use of laminated or powdered-iron cores
c. Use of shell or core type transformers
d. Use of low-reluctance paths for flux

5. If 386 volts is measured across the secondary of a trans
whose turns ratios 1:5.15, how much voltage is applied t
primary winding?

a. 51.5 volts
b. 75.0 volts
c. 19.9 volts
d. 76.5 volts

6. The turns ratio is required to match a 10 ohm speaker to
source impedance is

a. 1:1.
b. 60:1.
c. 6:1.
d. 38:1.

INTRODUCTION

The purpose of this assignment sheet is to familiarize y
various types of special transistor devices that you as
tronic technician will encounter. Consideration will be
to the operational characteristics as well as the inner
the devices studied.

LESSON TOPIC LEARNING OBJECTIVES

3.2.53. SELECT, from a given list, the advantages of a
compared to a bipolar device.

3.2.54. IDENTIFY, given the mil-spec symbol for a JFET,
drain and source.

3.2.55. SELECT, from a list of statements, the effect o
area and drain current for an input signal pola
N- or P-channel JFET.

3.2.56. LABEL, given the mil-spec symbol for an N-chann
P-channel JFET, the biasing polarities required
drain, gate and the source for normal operation

3.2.57. LABEL, given the mil-spec symbol for an N- or P
enhancement MOSFET, for the bias polarities req
gate, drain, and source for normal operation.

3.2.58. SELECT, from a list of statements, for the effe
channel area and drain current for a given inpu
polarity on the N- or P-channel enhancement MOS

3.2.59. LABEL, given the mil-spec symbol for an N- or P
depletion MOSFET, for the bias polarities requi
gate, drain, and scurce for normal operation.

3.2.60. SELECT, from a list of statements, for the effe
channel area and drain current for a given inpu
polarity on an N- or P-channel depletion MOSFE

3.2.61. SELECT, from a given list, the difference in d
for a zener and a normal PN junction diode.

3.2.62. SELECT, from a given list, the characteristi
mine the breakdown voltage on a zener diode.

SCR.

5. LABEL, on a given diagram, the anode, cathode, and the g of an SCR with the polarities needed for proper operatio

6. SELECT, from a given list of statements, the one which b describes the difference between a Silicon Controlled Rectifier and a Shockley diode.

7. LABEL, on a given diagram, B_1, B_2 the emitter, and the proper polarities for normal operation of the Unijunctio Transistor.

8. CALCULATE, given a diagram of a UJT with interbase volta and intrinsic standoff ratio, for the firing potential.

QUESTIONS

he JFET differs from the bipolar transistor in that it

. has unipolar majority carriers.
. is a voltage controlled device.
. resembles a pentode vacuum tube.
. utilizes a forward-biased PN junction for control of unipolar carriers.

hat polarities of bias voltage would be applied to a JFET's ate and drain for an N-channel? A P-channel?

s the gate voltage is increased in a JFET, what happens to t epletion region and drain ourrent?

5. List some of the advantages of the JFET.

6. What polarities of bias voltage would be applied to an ment MOSFET's gate and drain for an N-channel? A P-cha

7. What is the major difference between a JFET and enhance MOSFET in respect to biasing?

8. The zener diode operates on

   a. majority carriers and is normally forward biased.
   b. majority carriers and is normally reverse biased.
   c. minority carriers and is normally forward biased.
   d. minority carriers and is normally reverse biased.

9. The impedance of a PNPN diode prior to breakdown is

   a. low because of change multiplication.
   b. high because of an internal reverse-biased junctio
   c. low because of two forward-biased junctions.
   d. high because of a small value of minority current

10. In the basic SCR, the gate can/cannot initiate turn-o

11. In the SCR, after breakover,

   a. current flow is equal to I_H and is constant.
   b. load current is limited by load resistance.
   c. load current is equal to the gate current.
   d. load voltage is equal to the voltage across the S
   e. the SCR cannot be commutated.

The purpose of this assignment sheet is to familiari
various aspects of vacuum tube fundamentals. Consid
given to both the operational characteristics as wel
matical analysis of the circuits.

LESSON TOPIC LEARNING OBJECTIVES

4.1.1. SELECT, from the list provided, the four typ
tube emission.

4.1.2. MATCH, from the list provided, the component
vacuum tube with their functions.

4.1.3. SELECT, from the list provided, the definiti
Charge."

4.1.4. SELECT, from the list provided, for the outp
a given vacuum tube diode register circuit.

a. The plate
b. The filament
c. The control grid
d. The cathode

2. Which tube element is normally used for heat dissipat

a. The filaments
b. The envelope
c. The plate
d. The cathode

3. Which type of emission is the most commonly used?

a. Cold cathode
b. Thermonic
c. Secondary
d. Photoelectric

4. From the list below, select the correct statement(s) the SPACE CHARGE.

a. It is a space between two or more charged particl
b. It is a cloud of electrons.
c. It is never depleted to zero.
d. It exists in vacuum tubes which use thermal emiss
e. It limits the number of electrons being emitted cathode.
f. It may also be known as the VIRTUAL CATHODE.
g. It is a cloud of holes.

5. What are the two methods of heating the cathode?

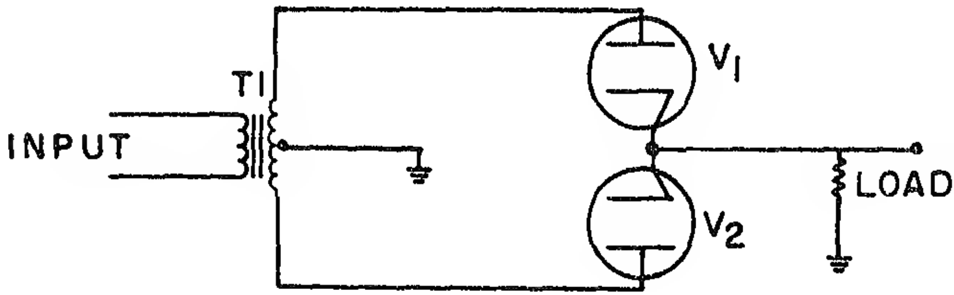
a. ____________________ and ____________________.

6. Define plate saturation.

____

____

c. Both the positive and negative half cycle.
d. None of the above-



The purpose of this assignment sheet is to familiarize
various aspects of triode vacuum tubes. Consideration
to both the operational analysis and the mathematical a
well as certain characteristics unique to triode vacuum

LESSON TOPIC LEARNING OBJECTIVES

4.2.1 SELECT, from a given list, the statement which
the placement of the control grid in a triode v

4.2.2 SELECT, from a given list, the statement which
the effect on plat current for given changes in
voltage.

4.2.3 SELECT, from a given list, the definition for m
r_p.

4.2.4 SELECT, given the schematic diagram of a triode
circuit, component values, and an E_b - I_b graph
line, the correct values of plate current for g
grid voltage.

4.2.5 DETERMINE, given an E_b - I_b graph with a load l
change in plate current for given changes in gr

4.2.6 MATCH, given a list of vacuum tube circuit nota
notation with its proper definition.

tetrode.
pentode.
triode.
variable mu.

ich electrostatic field, in a triode, has the greatest effec
tube current? The field between the

screen grid and plate.
control grid and plate.
control grid and cathode.
cathode and filament.

c plate voltage is designated by the circuit notation

E_{bb}
E_b
e_b
e_p

l tube element voltages are measured with respect to the

plate.
control grid.
cathode.
supply voltage.

lect, from the list below, the definition of bias.

The a-c difference of potential applied to the control gri
The d-c difference of potential between the control grid and plate
The d-c difference of potential between the control grid and the cathode
The d-c difference of potential between the cathode and th plate

e term μ (mu) is used to express

transconductance.
a-c plate resistance.
d-c plate resistance.
amplification factor.

b. between grid boltage and grid current.
c. between grid voltage and plate current.
d. plate voltage and grid current.

8. Which statement is true relative to the position of th
load resistor in a triode amplifier circuit? It is co

a. parallel with the a-c plate resistance of the tube
b. series with the a-c plate resistance of the tube.
c. parallel with the plate supply voltage.
d. series with the grid resistor.

9. What is the relationship of the three voltages found i
circuit of a triode amplifier?

a. $E_b = E_{R_L} + E_{bb}$

b. $E_{R_L} = E_b - E_{bb}$

c. $E_{bb} = E_b + E_{R_L}$

d. $E_b = E_{R_L} - E_{bb}$

10. What two values must be known to construct a load lin

a. R_L and E_b.

b. E_{bb} and E_L.

c. E_L and I_b.

d. E_{bb} and E_{cc}.

11. In addition to determining the maximum amplitude of
the dynamic transfer curve (DTC) may also be used
the operating point of the tube.

a. True.

b. False.

b. transconductance.
c. voltage gain.
d. interelectrode capacitance.

e purpose of this assignment sheet is to familiarize you wit
rious aspects of the multielement vacuum tubes. Considerati
given to the construction, operation and the characteristic
ch type of vacuum tube.

SSON TOPIC LEARNING OBJECTIVES

2.7. SELECT, from a given list, the major disadvantage of t tetrode vacuum tube.

2.8. SELECT, from a given list, the major advantage of the vacuum tube.

2.9. SELECT, from a given list, the major advantage of the beam-power tube.

2.10. MATCH, given a list of CRT elements and a list of eler functions, each element with its function.

TUDY QUESTIONS

Select, from the list below, the correct statements conce: the tetrode.

a. The screen grid is normally operated at a positive d-potential.
b. The suppressor grid is normally operated at cathode potential.
c. The tetrode has four elements.
d. The tetrode has less interelectrode capacitance than triode.
e. The tetrode has less interelectrode capacitance than the pentode.
f. The tetrode has a higher value of a-c plate resistanc the triode.
g. The tetrode is capable of a larger voltage gain than triode.
h. The tetrode has a wide operating range.

3. Which of the items listed below is not an element of th
pentode.

a. Control grid.
b. Buncher grid.
c. Suppressor grid.
d. Screen grid.

4. Concerning the pentode, which of the items listed below

a. The suppressor grid redues secondary emission
b. The pentode has a lower value of interelectrode cap
c. The pentode is capable of a higher voltage gain tha
tetrode or triode
d. The pentode has a wider operating range than the te

5. Concerning the beam-power tube, the virtual suppressor
located by the

a. cathode.
b. control grid.
c. plate.
d. beam-forming plates.

6. Which item(s) listed below are not elements of a CRT?

a. Accelerating anode.
b. Buncher grid.
c. Phosphor screen.
d. Focusing anode.
e. Deflection system.
f. Suppressor grid.
g. Aquadag coating.

7. The electronic lens is used to concentrate the electron
to light up the phosphor screen.

a. True
b. False

b. aperture width.
c. intensity.
d. none of the above.

9. The aquadag coating is used to

a. prevent light from entering the back of the CR
b. focus the electron beam.
c. prevent secondary emission.
d. prevent a negative charge from building up on

. $X_L = 2\pi fL$

. $X_C = \dfrac{1}{2\pi fC}$

SERIES ONLY

1. $Z_O = R$

2. E_{XL} or $E_{XC} = QE_A$

PARALLEL ONLY

1. $Z_T = \dfrac{Z_1 Z_2}{Z_1 + Z_2}$

2. $Z_O = \dfrac{E_A}{I_{line}}$

3. $Z_O = QX_L$

4. $Z_O = Q^2 R$

5. $Z_O = \dfrac{(X_L)^2}{R}$

6. $Z_O = \dfrac{L}{RC}$

7. $I_{tank} = QI_{line}$

8. $P_t = P_a \cos\theta$

9. $P_f = \dfrac{P_t}{P_a} = \cos\theta$

1. $\beta = \dfrac{I_C}{I_B}$

2. $\beta = \dfrac{\alpha}{1 - \alpha}$

3. $I_{CEO} = I_{CBO}(\beta + 1)$

4. $I_C = (\beta)(I_B) + (I_{CBO})($

COMMON BASE AMPLIFIER

1. $\alpha = \dfrac{I_C}{I_E}$

2. $\alpha = \dfrac{\beta}{\beta+1}$

COMMON COLLECTOR AMPLIFIER

1. $\gamma = \dfrac{I_E}{I_B}$

2. $\gamma = \beta + 1$

BIAS STABILITY

1. $S = \dfrac{(R_B + R_E)(\beta + 1)}{R_B + (\beta + 1)\ R_]}$

$2\pi\sqrt{LC}$

2. $Q = \dfrac{X_L}{R}$

3. $BW = \dfrac{F_o}{Q}$

4. $BW = \dfrac{R}{2\pi L}$

5. $X_L = X_C = L/C$

6. $F_o = \dfrac{X_L}{2\pi L}$

DECIBEL

A. $dB = 10\log(10)\ \dfrac{P_2}{P_1}$

B. $dB = 20\log(10)\ \dfrac{E_2}{E_1}\sqrt{\dfrac{Z_1}{Z_2}}$

C. $dB = 20\log(10)\ \dfrac{I_2}{I_1}\sqrt{\dfrac{Z_2}{Z_1}}$

FEEDBACK AMPLIFIERS

A. $A_f = \dfrac{A_v}{1 - \beta A_v}$

B. $e_\varepsilon = e_{in} + \beta e'_{out} = e_{in} + e_f$

C. $e'_{out} = \dfrac{A_v e_{in}}{1 - \beta A_v} = e_{in}A_f = e_\varepsilon A_v$

OP-AMPS

A. $E_{out} = (E_{in_2} \frac{R_f}{R_{s_2}}) + (- E_{in_1} \frac{R_f}{R_{s_1}})$

B. $E_{out} = e_{in} \frac{R_f}{R_s}$

TRANSFORMER RELATIONSHIPS

A. $TR = \frac{N_p}{N_s} = \frac{E_p}{E_s} = \frac{I_s}{I_p} = \sqrt{\frac{Z_p}{Z_s}}$

B. $Z_p = (TR)^2 (Z_s)$

VACUUM TUBE FUNDAMENTALS

A. D-c Plate Resistance

1. $R_p = \frac{E_b}{I_b}$

B. A-c Plate Resistance

1. $r_p = \frac{\Delta E_b}{\Delta I_b}$

TRIODES

A. Amplification Factor

1. $\mu = \frac{\Delta e_b}{\Delta e_c} = (gm)(r_p)$

B. Transconductance

1. $gm = \frac{\Delta i_b}{\Delta e_c} = (\mu)(r_p)$